



**US Army Corps
of Engineers**
Waterways Experiment
Station

Preliminary Data Summary January 2000 Field Research Facility

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The logo for Waterways Experiment Station (WES), consisting of the letters "WES" in a bold, italicized font, where each letter is composed of several horizontal lines.

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1 Introduction

The U.S. Army Corps of Engineers Waterways Experiment Station, Coastal and Hydraulics Laboratory (CHL), Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Figure 1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. Central to the FRF is the research pier, a reinforced concrete structure which extends from behind the duneline to about the 6-m water depth contour at a height of 7.75 m above the NGVD (1929 National Geodetic Vertical Datum).

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local bathymetric, oceanographic, and meteorological conditions. This is a preliminary which provides basic data soon after collection. Since they are preliminary further quality control may be applied to the data and made available via the internet at <http://www.frf.usace.army.mil>. Questions and/or comments concerning the data may be directed to Mr. Clifford F. Baron at (919)261-6840 ext.222 (*baronc@wes.army.mil*).

Chapter 2 presents the meteorological data; Chapters 3 through 6 present oceanographic data; Chapter 7 presents nearshore profiles and bathymetry; and Chapter 8 documents special events that occurred at the FRF during the month.

Table 1 is a list of instruments used and their operational status during the month. Figure 2 shows weather and ocean conditions for the month. Table 2 and Figure 3 identifies the location of the instruments. The water depths at the wave gauges and current meters vary and may be determined from information contained in Figure 9. Other installation information is contained in Table 2.

Times given in the report are referenced to eastern standard time (EST).



Figure 1. FRF Location Map

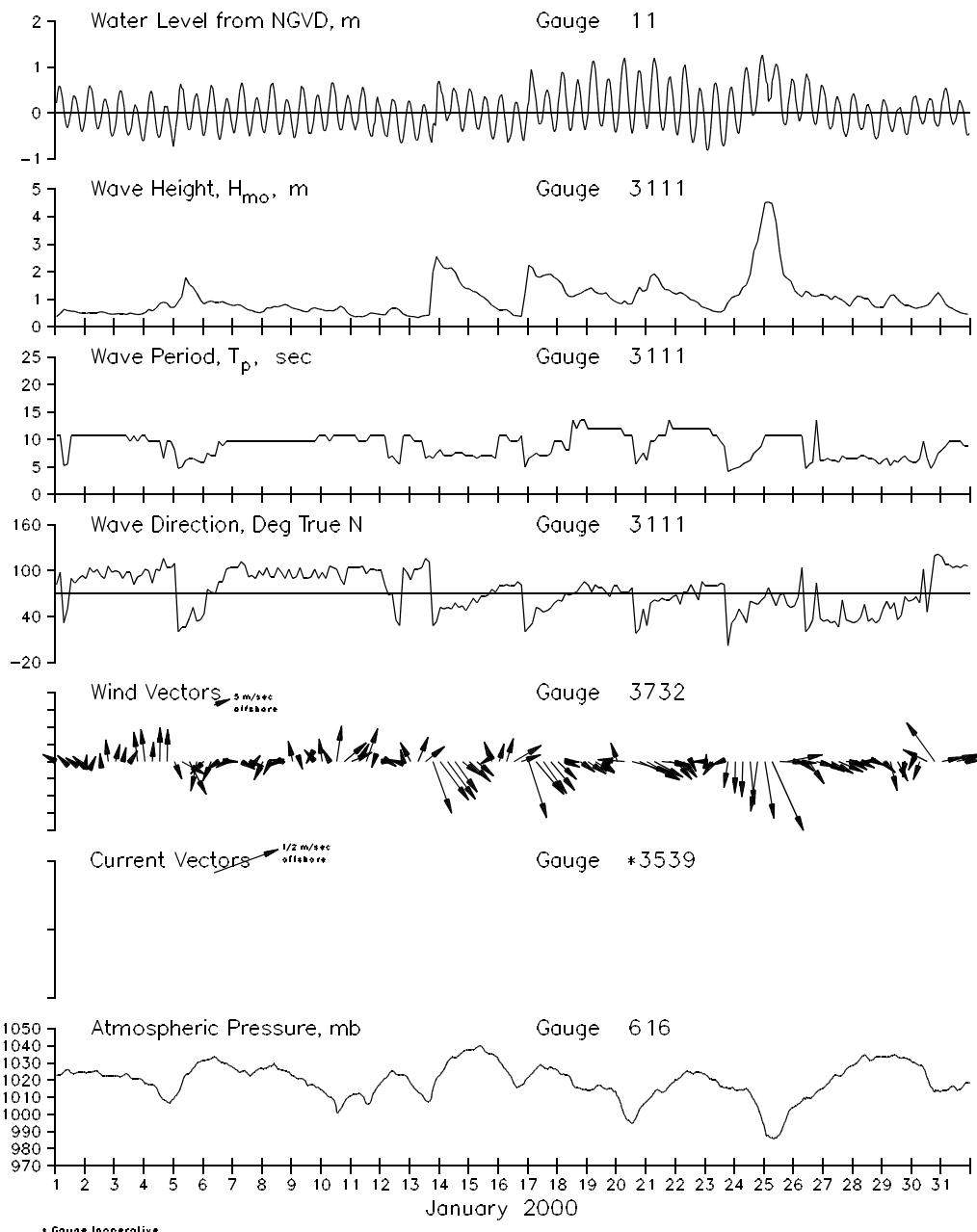


Figure 2. Month at a Glance

Table 1
Instrument Status/Data Availability

Table 2 Gauge Locations

Gauge ID	Description	Latitude Degrees N	Longitude Degrees W	FRF Coordinates Crossshore m	Longshore m	Gauge Depth NGVD, m	Water Depth NGVD, m
616	Atmospheric Pressure	36 10' 57.03"	75 45' 5.50"	11.60	569.00	-----	-----
3932	Anemometer	36 11' 1.23"	75 44' 43.07"	585.20	517.30	19.50	-----
641	Pressure Gauge	36 10' 57.71"	75 44' 56.23"	239.11	516.64	-1.64	-1.96
625	Baylor Staff	36 11' 1.04"	75 44' 43.72"	568.00	516.64	Surface	-8.36
3111	8 Meter Array North	36 11' 19.14"	75 44' 36.41"	915.23	990.16	-7.50	-7.90
	8 Meter Array South	36 11' 11.28"	75 44' 33.28"	914.20	735.37	-7.42	-7.90
	8 Meter Array East	36 11' 13.70"	75 44' 32.56"	954.51	800.58	-7.62	-8.13
	8 Meter Array West	36 11' 12.48"	75 44' 37.11"	834.66	800.37	-6.98	-7.44
111	Pressure Gauge in center of 8 M Array	36 11' 14.06"	75 44' 34.39"	914.43	825.52	-7.76	-8.08
630	Waverider Buoy	36 10' 5.10"	75 41' 59.30"	3934.96	-2400.81	Surface	-17.00
3539	Current Meter	36 11' 23.57"	75 44' 9.12"	1605.80	907.60	-11.60	-11.70
11	NOAA Tide Gauge	36 11' 1.25"	75 44' 42.60"	596.49	514.20	Surface	-7.62

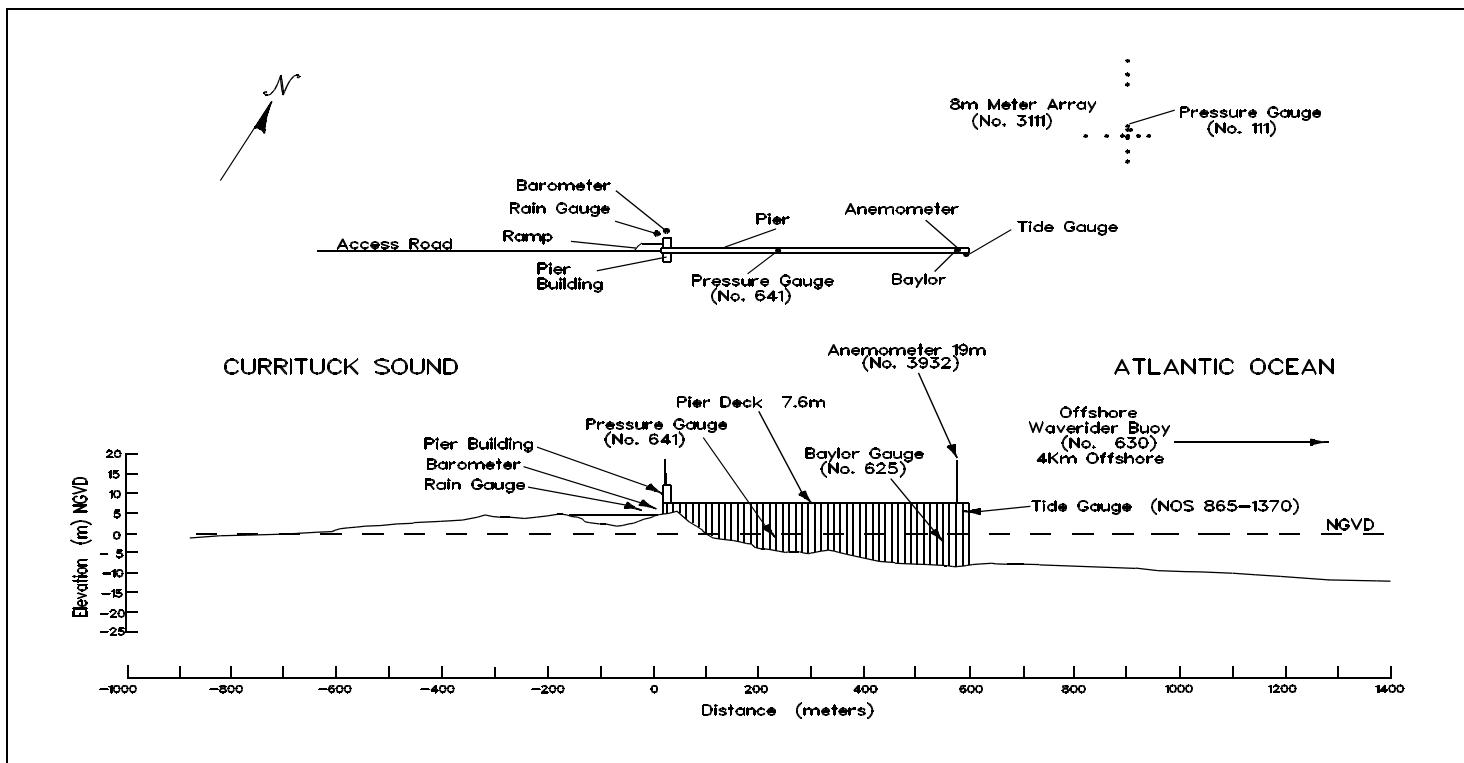


Figure 3. Instrument Locations, Elevations From NGVD

2 Meteorological Data

A variety of instruments have been installed at the FRF (Figure 3) to monitor the meteorological conditions. The data presented in Table 3 are collected and stored using a Digital Equipment Corporation VAXstation 4000. For each instrument identified in Table 1, a log is maintained and the records are stored for future reference.

Winds were measured at the end of the pier at an elevation of 19 m using a WeatherMeasure Skyvane anemometer. Monthly resultant wind speeds and directions (Figure 4) are determined by vector averaging the data. Wind directions (Table 3) indicate where the wind is coming from. Temperature and atmospheric pressure means (Table 3) are the average of the values presented for the month. Total precipitation is the sum for the month.

The following may be useful for converting the data in Table 3 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in.) -
 $mm \times .03937 = in.$
2. Millibars (mb) to inches of mercury (in. Hg) -
 $mb \times 0.02953 = in. Hg$
3. Degrees Celsius (C) to degrees Fahrenheit (F) -
 $(C \times 9/5) + 32 = F$
4. Meters per second (m/s) to knots (kn) -
 $m/s \times 1.943 = kn$

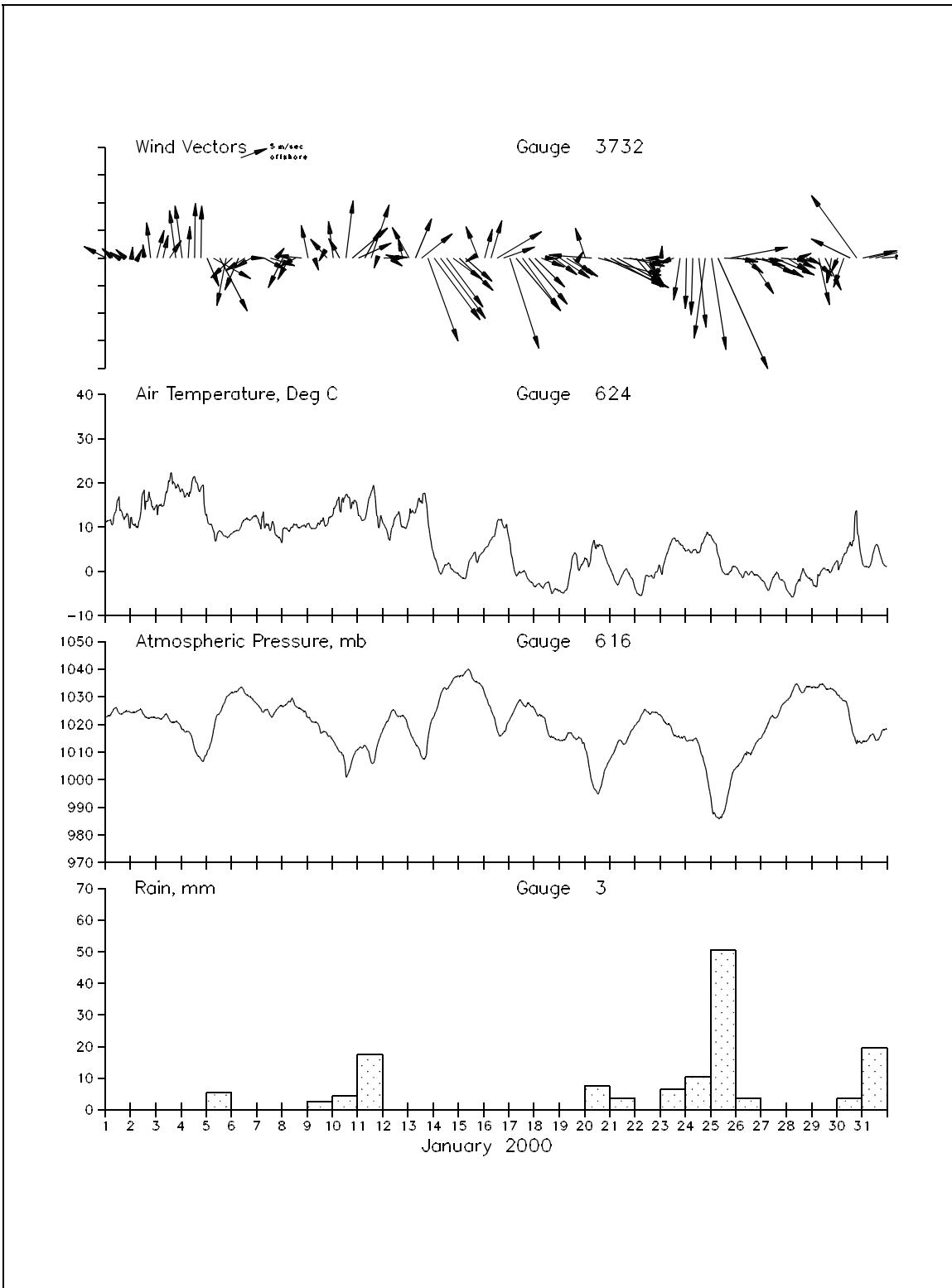


Figure 4. Meteorological Monthly Summary

Table 3
Meteorological Data

Jan 2000						
Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
1	100	5	255	1.0	1017.4	0
	700	3	132	10.6	1024.8	0
	1300	2	123	16.9	1024.2	0
	1900	2	131	12.4	1024.7	0
2	100	2	185	12.3	1024.2	0
	700	2	205	9.9	1025.1	0
	1300	2	174	18.4	1023.5	0
	1900	6	173	16.2	1022.6	0
3	100	5	194	15.1	1022.2	0
	700	4	192	14.8	1022.7	0
	1300	4	214	20.3	1021.9	0
	1900	9	172	18.8	1021.1	0
4	100	10	172	18.7	1018.2	0
	700	6	182	17.4	1017.5	0
	1300	10	180	21.4	1011.3	0
	1900	9	180	18.9	1007.6	0
5	100	6	337	12.2	1009.9	0
	700	8	299	9.2	1017.9	5
	1300	11	332	9.2	1024.3	0
	1900	9	10	7.9	1029.6	0
6	100	5	47	8.7	1031.5	0
	700	6	23	9.3	1032.8	0
	1300	4	56	11.8	1031.4	0
	1900	3	58	11.8	1029.8	0
7	100	1	271	12.1	1027.1	0
	700	5	298	10.7	1024.8	0
	1300	5	287	9.2	1023.4	0
	1900	2	218	8.0	1025.5	0
8	100	6	26	9.6	1026.5	0
	700	4	27	9.2	1028.3	0
	1300	3	61	10.4	1026.7	0
	1900	5	95	10.2	1025.3	0
9	100	6	167	10.8	1022.5	0
	700	2	340	9.7	1021.0	2
	1300	1	30	11.5	1016.9	0
	1900	5	138	10.5	1016.8	0
10	100	7	172	13.1	1014.3	0
	700	4	150	13.9	1010.2	5
	1300	10	187	17.4	1001.3	0
	1900	8	229	15.7	1007.1	0

Table 3
Meteorological Data (continued)

Jan 2000						
Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
11	100	7	245	12.7	1011.2	0
	700	6	208	11.9	1012.5	17
	1300	10	198	17.9	1006.4	0
	1900	2	18	12.5	1012.8	0
12	100	4	268	10.7	1018.8	0
	700	3	303	7.2	1023.0	0
	1300	2	106	12.6	1023.7	0
	1900	4	167	10.2	1023.2	0
13	100	6	151	12.0	1018.4	0
	700	8	202	13.2	1013.3	0
	1300	7	231	15.6	1008.5	0
	1900	16	340	11.8	1014.7	0
14	100	14	323	3.3	1023.2	0
	700	14	323	-0.5	1030.8	0
	1300	11	323	1.5	1032.9	0
	1900	6	306	0.3	1036.4	0
15	100	8	314	-0.9	1037.5	0
	700	6	311	-1.6	1039.2	0
	1300	1	58	3.3	1037.2	0
	1900	6	158	2.5	1035.1	0
16	100	5	195	5.1	1031.2	0
	700	7	196	7.1	1025.5	0
	1300	9	239	11.1	1018.0	0
	1900	6	251	10.1	1017.2	0
17	100	17	342	6.6	1022.0	0
	700	12	319	-1.0	1026.8	0
	1300	12	324	0.0	1027.8	0
	1900	11	320	-1.9	1027.6	0
18	100	7	314	-3.5	1025.5	0
	700	4	291	-3.4	1023.1	0
	1300	2	273	-2.6	1017.5	0
	1900	5	306	-4.2	1015.3	0
19	100	6	304	-4.4	1014.2	0
	700	7	300	-4.1	1015.7	0
	1300	5	311	3.6	1016.0	0
	1900	1	212	0.2	1015.4	0
20	100	6	161	2.8	1011.0	0
	700	8	94	5.2	999.6	7
	1300	12	285	5.6	994.9	0
	1900	13	294	4.1	1003.0	0

Table 3
Meteorological Data (concluded)

Jan 2000						
Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
21	100	11	298	0.4	1007.9	0
	700	10	298	-3.0	1012.8	4
	1300	8	275	-0.4	1013.1	0
	1900	7	283	-0.8	1016.3	0
22	100	7	319	-4.3	1020.0	0
	700	6	320	-5.0	1024.0	0
	1300	3	334	-1.1	1024.5	0
	1900	2	89	-0.5	1024.4	0
23	100	2	183	-0.2	1023.1	0
	700	5	37	4.3	1020.0	6
	1300	3	69	7.5	1016.1	0
	1900	8	8	6.1	1015.1	0
24	100	9	1	4.6	1014.3	0
	700	10	1	4.7	1014.1	10
	1300	13	354	4.2	1012.8	0
	1900	15	7	7.9	1004.8	0
25	100	17	351	7.6	991.1	0
	700	22	335	3.8	986.5	51
	1300	11	272	-0.4	988.5	0
	1900	11	259	0.0	999.2	0
26	100	4	280	0.8	1004.8	0
	700	5	307	-1.4	1008.0	3
	1300	8	326	-0.6	1009.7	0
	1900	5	285	-0.8	1013.3	0
27	100	7	296	-2.0	1015.7	0
	700	7	298	-4.3	1020.6	0
	1300	8	293	-0.9	1022.4	0
	1900	5	275	-2.0	1026.2	0
28	100	5	301	-4.3	1028.8	0
	700	4	295	-5.6	1032.9	0
	1300	2	248	-2.2	1032.6	0
	1900	3	293	-1.0	1033.6	0
29	100	5	312	-2.4	1033.4	0
	700	9	347	-1.0	1033.7	0
	1300	6	333	0.6	1033.8	0
	1900	5	9	0.1	1032.8	0
30	100	3	24	2.3	1030.5	0
	700	6	19	3.7	1028.8	3
	1300	8	116	6.7	1021.4	0
	1900	14	144	13.7	1013.0	0
31	100	6	257	1.6	1013.9	0
	700	8	255	1.0	1015.3	19
	1300	7	256	5.9	1014.6	0
	1900	5	266	2.6	1017.5	0
		Resultant		Mean	Mean	Total
		3	300	6.0	1019.6	132

3 Wave Data

Wave data are collected from three different sets of instruments, as shown in Table 1 and Figure 3. The first is an array of fifteen pressure gauges, collectively referred to as gauge 3111 (gauge 111 being one of them). Directional information is computed from these gauges using an iterative maximum likelihood estimator. The second is a Baylor staff gauge (625) and a pressure gauge (641), both attached to the pier. The third is a Waverider buoy (630). The data are collected, analyzed, and stored on optical disc using a Digital Equipment Corporation VAXstation 4000. Data is sampled at 2 Hertz, with five contiguous 34 minute records, for a total collection period of nearly 2 hours and 51 minutes. This report reflects the data collection periods of 0100, 0700, 1300, and 1900 EST. The results are based only on the first 34 minute record. The exception is the 8 Meter Array (3111) which condenses the first four records into one statistical value.

Wave height H_{mo} is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. Wave height reported from the pressure gauge has been compensated for hydrodynamic attenuation using linear wave theory. Wave period is identified from the computation of a variance (energy) spectrum with 60 degrees of freedom calculated from a 34-min record. Peak wave period T_p is defined as the period associated with the maximum energy in the spectrum.

Table 4 presents the wave heights and periods for each wave record obtained at 6 hr intervals during the month. The monthly means and standard deviations from the means shown in Table 4 are average values computed from this data. Figure 5 is a time history of all H_{mo} and T_p values obtained for all gauges.

Differences in wave periods between wave gauges (Table 4 and Figure 5) may be the result of wave breaking, wave reformation, the presence of multiple wave trains containing nearly equal energy, and statistical variations in spectral estimations.

Table 4
Wave Data

Jan 2000											
Day	Hour	641 Pressure Gauge		625 Baylor Gauge		3111 8 Meter Array			630 Waverider		
		Hmo,m	Tp,sec	Hmo,m	Tp,sec	Hmo,m	Tp,sec	Dir,TN	Hmo,m	Tp,sec	
1	0100	0.17	9.2	0.38	9.9	0.37	10.8	82	0.44	10.6	
	0700	0.44	5.3	0.57	10.3	0.63	5.3	32	0.71	5.3	
	1300	0.36	5.5	0.57	10.3	0.56	10.8	90	0.63	5.3	
	1900	0.28	10.7	0.53	10.7	0.50	10.8	90	0.60	10.6	
	0100	0.25	11.2	0.45	10.7	0.49	10.8	90	0.56	10.6	
2	0700	0.28	10.7	0.47	10.3	0.50	10.8	98	0.61	10.6	
	1300	0.25	9.9	0.56	10.3	0.53	10.8	94	0.64	10.6	
	1900	0.26	10.3	0.48	10.7	0.48	10.8	106	0.59	11.2	
	0100	0.23	10.7	0.47	9.9	0.46	10.8	100	0.55	10.1	
3	0700	0.28	11.2	0.43	10.3	0.47	10.8	90	0.56	10.1	
	1300	0.23	10.3	0.48	10.3	0.49	9.8	98	0.56	10.1	
	1900	0.26	9.9	0.46	9.9	0.44	9.8	92	0.55	11.2	
	0100	0.27	10.7	0.51	10.3	0.51	10.8	102	0.63	10.1	
4	0700	0.38	10.3	0.55	10.3	0.58	9.8	84	0.78	10.6	
	1300	0.49	3.3	0.80	10.7	0.84	9.8	100	1.08	6.7	
	1900	0.60	7.6	0.81	7.4	0.85	9.8	104	1.22	9.1	
	0100	0.31	7.8	0.61	9.5	0.71	8.2	110	0.81	10.1	
5	0700	0.60	5.1	0.79	4.6	1.11	5.0	26	1.05	4.6	
	1300	0.78	6.8	1.59	6.6	1.54	6.6	38	1.90	6.3	
	1900	0.93	6.3	1.22	6.5	1.22	6.2	34	1.56	6.7	
	0100	0.55	4.9	0.94	6.0	0.83	5.9	44	1.08	5.9	
6	0700	0.66	7.0	1.01	7.8	0.94	7.1	72	1.13	7.2	
	1300	0.50	5.7	0.90	6.8	0.88	9.8	86	1.03	10.1	
	1900	0.49	5.3	0.85	9.5	0.84	9.8	102	1.05	10.1	
	0100	0.30	9.5	0.80	9.5	0.77	9.8	104	0.93	9.1	
7	0700	0.44	8.6	0.70	9.9	0.77	9.8	112	0.84	10.1	
	1300	0.24	9.9	0.61	9.9	0.61	9.8	92	0.81	10.1	
	1900	0.24	9.5	0.49	9.5	0.53	9.8	90	0.64	9.1	
	0100	0.17	9.9	0.44	9.9	0.54	9.8	94	0.51	10.1	
8	0700	0.49	4.7	0.72	4.7	0.67	9.8	92	1.02	10.1	
	1300	0.40	5.6	0.72	9.9	0.72	9.8	104	0.80	10.1	
	1900	0.41	10.7	0.77	9.2	0.81	9.8	90	0.94	9.1	
	0100	0.25	10.7	0.70	10.7	0.67	9.8	90	0.80	5.9	
9	0700	0.32	10.3	0.52	9.5	0.61	9.8	104	0.67	10.6	
	1300	0.23	10.3	0.57	10.3	0.53	9.8	90	0.61	10.1	
	1900	0.36	9.9	0.62	9.9	0.68	9.8	102	0.78	10.1	
	0100	0.29	10.3	0.61	10.3	0.62	10.8	98	0.73	11.2	
10	0700	0.33	9.9	0.54	10.3	0.59	9.8	106	0.71	10.6	
	1300	0.37	10.7	0.60	10.3	0.65	10.8	102	0.79	10.1	
	1900	0.48	6.6	0.68	6.6	0.67	10.8	82	0.97	6.3	

Table 4
Wave Data (continued)

Jan 2000											
Day	Hour	641 Pressure Gauge		625 Baylor Gauge		3111 8 Meter Array			630 Waverider		
		Hmo,m	Tp,sec	Hmo,m	Tp,sec	Hmo,m	Tp,sec	Dir,TN	Hmo,m	Tp,sec	
11	0100	0.22	10.7	0.40	10.7	0.40	10.8	104	0.57	10.1	
	0700	0.18	10.3	0.30	10.7	0.38	9.8	104	0.50	10.6	
	1300	0.26	10.3	0.42	10.3	0.41	9.8	96	0.73	10.1	
	1900	0.30	10.7	0.50	10.3	0.48	10.8	102	0.68	10.6	
12	0100	0.27	4.1	0.47	4.2	0.44	10.8	100	0.57	11.2	
	0700	0.27	3.8	0.54	7.4	0.59	6.6	68	0.65	10.1	
	1300	0.46	5.4	0.70	6.5	0.68	6.2	36	0.84	7.2	
	1900	0.22	4.7	0.50	5.4	0.46	10.8	104	0.62	10.6	
13	0100	0.22	11.2	0.39	10.3	0.37	10.8	88	0.51	10.6	
	0700	0.19	2.7	0.35	9.5	0.33	9.8	102	0.53	10.1	
	1300	0.25	6.8	0.34	9.9	0.40	6.6	116	0.59	5.9	
	1900	0.73	4.8	1.23	4.7	1.98	6.6	28	1.35	4.6	
14	0100	1.20	8.1	2.10	7.2	2.32	8.2	52	2.63	7.2	
	0700	0.79	7.8	1.95	7.8	2.10	7.1	52	2.47	7.7	
	1300	1.15	6.5	2.01	7.6	2.00	7.6	58	2.39	8.4	
	1900	0.61	6.6	1.45	8.3	1.48	7.6	54	1.81	7.7	
15	0100	1.14	6.0	1.28	6.6	1.36	7.1	56	1.66	7.2	
	0700	0.67	7.0	1.24	7.6	1.24	6.6	58	1.46	7.2	
	1300	0.84	6.6	1.04	7.2	1.05	7.1	66	1.29	5.9	
	1900	0.48	6.9	0.82	5.7	0.79	7.1	76	1.01	7.7	
16	0100	0.42	6.3	0.62	10.3	0.61	10.8	80	0.76	11.2	
	0700	0.29	11.1	0.58	10.7	0.62	10.8	82	0.75	10.6	
	1300	0.26	10.3	0.38	9.9	0.40	9.8	80	0.67	10.1	
	1900	0.20	7.6	0.38	9.5	0.38	10.8	82	0.48	8.4	
17	0100	1.17	6.5	1.93	6.5	2.23	6.6	26	2.40	6.3	
	0700	0.91	7.0	1.72	8.1	1.82	7.6	52	2.20	7.2	
	1300	0.91	7.0	1.74	7.2	1.87	7.1	46	2.17	7.7	
	1900	0.79	10.3	1.89	9.9	1.91	7.6	52	2.23	10.1	
18	0100	0.97	7.2	1.66	9.5	1.71	9.8	62	1.98	10.1	
	0700	0.94	7.2	1.23	9.2	1.25	8.2	70	1.63	9.1	
	1300	0.63	7.4	1.06	12.9	1.09	13.6	70	1.19	5.9	
	1900	0.71	14.3	1.04	12.2	1.22	13.6	80	1.14	14.3	
19	0100	0.75	12.9	1.28	12.9	1.36	12.0	82	1.41	12.6	
	0700	1.02	12.9	1.13	12.2	1.26	12.0	82	1.49	13.4	
	1300	0.60	11.7	1.06	12.2	1.19	12.0	78	1.16	11.8	
	1900	0.79	5.6	1.01	11.7	1.05	12.0	66	1.07	11.2	
20	0100	0.45	12.9	0.88	12.2	0.87	12.0	80	0.92	11.2	
	0700	0.71	11.7	0.92	11.2	0.94	10.8	72	1.09	11.1	
	1300	0.39	11.7	0.79	10.7	0.84	10.8	78	0.98	10.6	
	1900	1.20	6.5	1.26	6.3	1.43	6.6	24	1.28	5.6	

Table 4
Wave Data (concluded)

Jan 2000										
Day	Hour	641 Pressure Gauge		625 Baylor Gauge		3111 8 Meter Array			630 Waverider	
		Hmo,m	Tp,sec	Hmo,m	Tp,sec	Hmo,m	Tp,sec	Dir,TN	Hmo,m	Tp,sec
21	0100	0.61	6.3	1.31	7.6	1.35	6.2	28	inoperative	
	0700	1.83	8.1	1.93	9.5	1.93	9.8	62		
	1300	0.81	11.1	1.53	10.7	1.51	10.8	64		
	1900	1.16	12.2	1.32	13.5	1.34	13.6	62		
22	0100	0.67	12.8	1.15	12.2	1.19	12.0	68		
	0700	1.18	6.6	1.15	6.3	1.19	12.0	72		
	1300	0.54	13.5	1.03	12.9	0.98	12.0	82		
	1900	0.62	12.2	0.78	12.9	0.86	12.0	62		
23	0100	0.33	12.2	0.63	12.9	0.67	12.0	80	inoperative	
	0700	0.43	11.7	0.60	11.2	0.56	10.8	80		
	1300	0.27	15.1	0.55	10.3	0.53	9.8	84		
	1900	0.63	3.7	0.83	3.8	0.89	4.2	2		
24	0100	0.77	4.7	1.10	4.8	1.12	4.8	38		
	0700	1.21	5.1	1.28	5.6	1.43	5.6	42		
	1300	1.16	6.0	1.60	6.1	1.89	6.2	60		
	1900	1.46	7.8	2.77	8.3	3.10	8.2	56		
25	0100	1.67	10.3	3.40	10.3	4.51	10.8	66		
	0700	1.92	11.7	3.36	11.2	4.47	10.8	66		
	1300	1.99	11.2	2.73	11.7	2.69	10.8	68		
	1900	1.23	11.7	1.59	10.7	1.76	10.8	56		
26	0100	1.07	11.2	1.36	10.7	1.33	10.8	54		
	0700	0.77	5.3	1.03	10.3	1.09	10.8	104		
	1300	1.08	6.3	1.10	5.4	1.23	5.6	26		
	1900	0.86	5.9	1.04	5.7	1.10	13.6	84	inoperative	
27	0100	1.05	6.0	1.09	15.1	1.14	6.2	34		
	0700	0.96	6.3	1.00	6.1	0.99	6.2	32		
	1300	1.04	6.1	0.92	5.9	1.03	5.9	26		
	1900	0.78	6.8	0.85	6.6	0.87	6.6	36		
28	0100	0.77	6.5	0.72	6.3	0.96	6.6	32		
	0700	0.98	6.5	1.07	6.8	1.09	7.1	40		
	1300	0.95	6.0	0.95	6.8	1.02	6.6	34		
	1900	0.58	6.1	0.70	7.8	0.71	6.2	32		
29	0100	0.63	5.9	0.60	6.3	0.70	6.2	50		
	0700	0.95	5.5	1.15	6.1	1.14	5.3	50		
	1300	0.96	5.7	1.04	5.7	1.01	5.9	36		
	1900	0.67	6.1	0.82	6.8	0.78	7.1	66		
30	0100	0.58	5.7	0.71	6.3	0.71	5.9	62		
	0700	0.51	5.4	0.74	6.3	0.69	6.6	58		
	1300	0.53	5.2	0.79	6.6	0.77	6.6	46		
	1900	0.52	5.4	1.04	5.6	1.10	5.9	120		
31	0100	0.55	9.2	0.95	8.9	1.07	8.2	118		
	0700	0.37	8.3	0.63	9.2	0.71	9.8	108		
	1300	0.27	9.9	0.56	9.2	0.58	9.8	106		
	1900	0.24	8.9	0.48	8.9	0.47	8.9	108		
Mean		0.63	8.3	0.96	8.9	1.02	9.1	72	1.07	9.3
Std dev		0.38	2.7	0.57	2.3	0.68	2.2	26	0.56	2.1

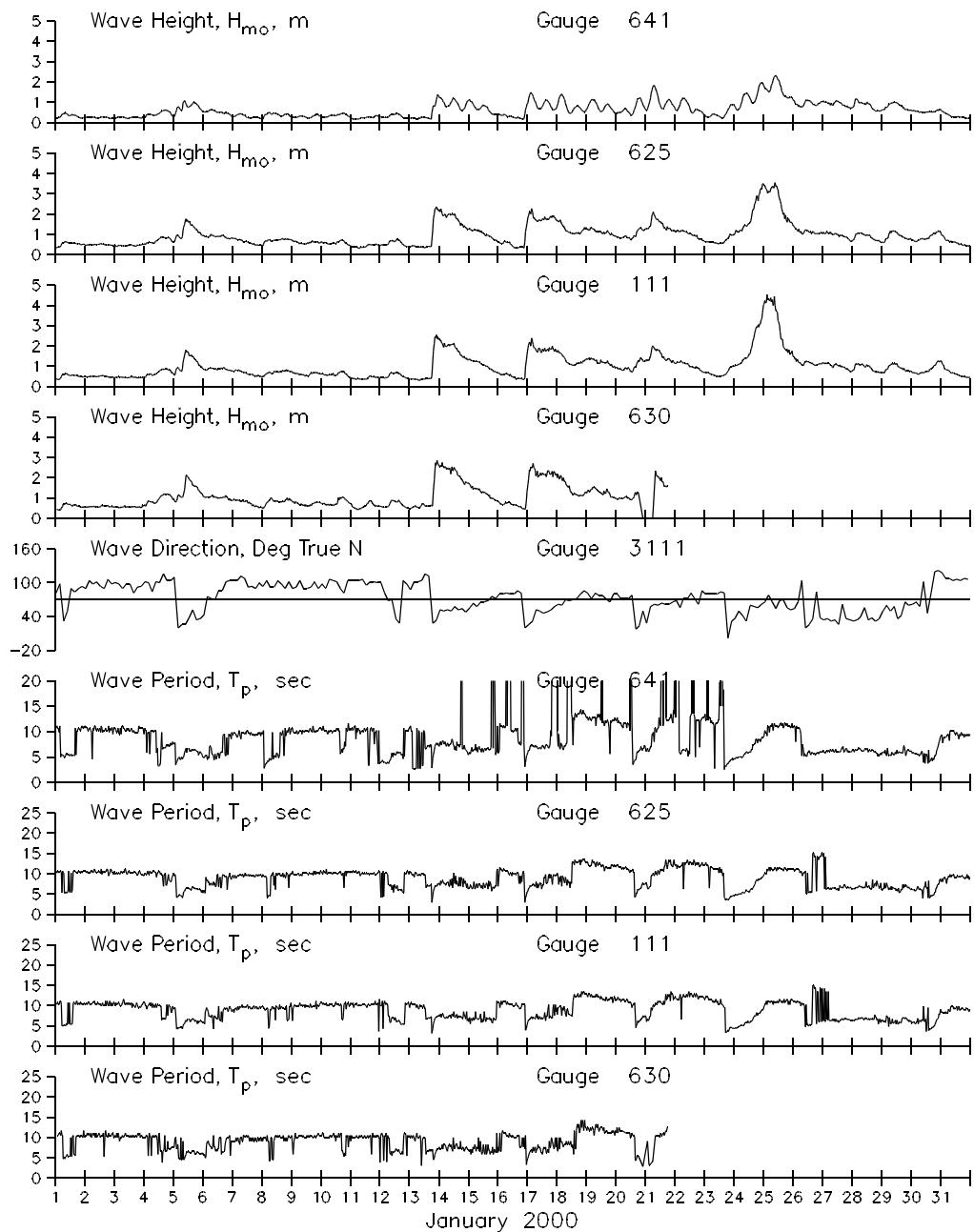


Figure 5. Wave Heights and Periods

4 Current Data

Current data (Table 5) are collected from a Sontek acoustic current meter and by visually observing the movement of small drogues on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier, approximately 12 m offshore (Table 6).

Since the shoreline orientation is approximately N20W, longshore currents flow either toward 340 deg (i.e. northward) or toward 160 deg (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward). All current speeds are given in centimeters per second (cm/sec). Resultant speeds and directions are determined by vector averaging the cross-shore and longshore data. Current directions indicate the direction that the current is moving towards. Current data are plotted in Figure 2.

Table 5
Current Meter Data - Gauge 3539

JANUARY 2000											
		Cross	Long			Cross	Long			Cross	Long
Day	Time	Shore	Shore	Speed	Dir	Day	Time	Shore	Shore	Speed	Dir
1	100			1300		22	100			100	
	700			1900			700			700	
	1300				12 100					1300	
	1900		Data		700					1900	
2	100			1300		23	100			700	
	700	available		1900			700			1300	
	1300				13 100					1900	
	1900	at a			700					100	
3	100			1300		24	100			700	
	700	later		1900			700			1300	
	1300				14 100					1900	
	1900	date.			700					100	
4	100			1300		25	100			700	
	700			1900			700			1300	
	1300				15 100					1900	
	1900				700					100	
5	100			1300		26	100			700	
	700			1900			700			1300	
	1300				16 100					1900	
	1900				700					100	
6	100			1300		27	100			700	
	700			1900			700			1300	
	1300				17 100					1900	
	1900				700					100	
7	100			1300		28	100			700	
	700			1900			700			1300	
	1300				18 100					1900	
	1900				700					100	
8	100			1300		29	100			700	
	700			1900			700			1300	
	1300				19 100					1900	
	1900				700					100	
9	100			1300		30	100			700	
	700			1900			700			1300	
	1300				20 100					1900	
	1900				700					100	
10	100			1300		31	100			700	
	700			1900			700			1300	
	1300				21 100					1900	
	1900				700					100	
11	100			1300			1300			1900	
	700			1900						100	

KEY:

+cross-shore = offshore, cm/sec
 -cross-shore = onshore, cm/sec
 +longshore = south, cm/sec
 -longshore = north, cm/sec
 Speed = Resultant speed, cm/sec
 Dir = Resultant direction, degrees true north

Table 6
Visually Observed Current Data

Jan 2000												
Day	Pier End					Mid-Surf Zone				Beach		
	Cross Shore	Long Shore	Speed	Dir		Cross Shore	Long Shore	Speed	Dir	Location	Speed	Dir
1	1	16	16	157		28	14	32	95	North	20	S
2	0	16	16	160		16	-47	50	359	South	30	N
3	7	-24	25	357		68	-68	96	25	South	26	N
4	15	-30	34	7		3	-51	51	343	South	55	N
5	11	76	77	151		8	30	31	146	North	61	S
6	-2	8	8	171		-5	24	25	171	North	8	S
7	0	20	20	160		14	-20	25	15	North	23	N
8	-5	10	11	187		0	15	15	160	North	9	S
9	0	-12	12	340		0	-44	44	340	South	9	N
10	0	-27	27	340		0	-34	34	340	South	10	N
11	12	-24	27	7		15	30	34	133	South	18	N
12	0	-10	10	340		0	51	51	160	North	27	S
13	19	-25	32	17		0	-30	30	340	South	15	N
14	0	51	51	160		0	61	61	160	North	73	S
15	17	34	38	133		0	47	47	160	North	43	S
16	13	-25	28	7		-3	-13	13	326	South	0	
17	0	61	61	160		0	76	76	160	North	71	S
18	0	36	36	160		0	44	44	160	North	15	S
19	0	47	47	160		0	47	47	160	North	15	S
20	-10	-20	23	313		-14	-19	24	303	South	15	N
21	22	44	49	133		0	76	76	160	North	61	S
22	0	17	17	160		0	51	51	160	North	26	S
23	0	-25	25	340		-4	-9	10	313	South	18	N
24	0	61	61	160		-9	87	88	166	North	38	S
25	no observation					no observation				no observation		
26	12	34	36	141		-4	41	41	166	North	45	S
27	6	30	31	149		-6	-41	41	331	North	41	S
28	8	30	31	146		-2	30	31	163	North	45	S
29	-3	51	51	163		-6	41	41	169	North	41	S
30	-12	14	18	202		-7	20	22	179	North	13	N
31	14	14	19	115		-2	-30	31	337	South	6	N

KEY:

+cross-shore = offshore, cm/sec
 -cross-shore = onshore, cm/sec
 +longshore = south, cm/sec
 -longshore = north, cm/sec
 Speed = Resultant speed, cm/sec
 Dir = Resultant direction, degrees true north

5 Visual Observations

Visual wave direction measurements (Table 7) of both the primary wave train (i.e. that having the higher wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves but not surface chop or capillary waves) are taken daily at the seaward end of the pier. The pier axis (considered perpendicular to the beach at the FRF) is oriented 70 deg east of true north; consequently, wave angles greater than 70 deg indicate that the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and depth of visibility are also taken daily at the seaward end of the pier. A Bucket Thermometer is lowered about 0.3 m into the water and allowed to remain for at least one minute. The temperature is then read, and a hydrometer is used to determine the density. A Secchi disc is used to determine the depth of visibility.

Table 7
Visual Observations

Jan 2000

Day	Time	Wave Approach Angle at Pier End (degrees from True N)		Surf Zone	Width, m	Water Characteristics at Pier End		
		Primary	Secondary			Temp., C	Density g/cc	Secchi Vis., m
1	0815	15	50		70	11.1	1.0248	3.7
2	0710	120	60			8.3	1.0216	2.7
3	1000	80	110		104	11.1	1.0246	1.2
4	0815	100			99	11.4	1.0246	1.2
5	0730	40			94	11.7	1.0244	0.9
6	0830	50	60		150	10.9	1.0249	0.9
7	0730	90	50		98	10.7	1.0249	1.2
8	0730	45	90		61	8.9	1.0227	3.0
9	0900	95	50		49	8.9	1.0223	3.7
10	0700	95			61	10.2	1.0221	3.4
11	0740	105			61	11.2	1.0247	1.2
12	0715	95	40		91	11.3	1.0249	0.9
13	0700	105			85	11.9	1.0247	0.9
14	0800	35			152	8.9		0.6
15	0900	45			146	8.8	1.0246	0.6
16	0800	95	130		101	8.6	1.0239	0.9
17	0700	45	979		122	8.3		0.6
18	0740	40			143	7.0	1.0239	0.6
19	0715	85	15		128	6.0	1.0235	1.5
20	0750	65	95		79	6.5	1.0227	2.4
21	0700	55	20		232	6.4	1.0235	0.6
22	0715	40			107	6.0	1.0240	0.9
23	0900	80			67	6.1	1.0239	1.5
24	0930	20			91	6.3	1.0244	0.9
25	0715	no observation			588			
26	0815	60	40		107	4.2	1.0234	0.6
27	0820	40			116	3.3	1.0244	0.6
28	0820	40			122	3.4	1.0245	0.3
29	0700	40			128	1.9	1.0233	0.6
30	1100	50	80		110	2.2	1.0226	0.9
31	0730	100			123	2.6	1.0238	0.9

6 Water Levels

Since 1978, the National Oceanic and Atmospheric Administration (NOAA)/National Ocean Service (NOS) has operated a primary tide station (No. 865-1370) at the seaward end of the FRF pier. A NOS acoustic tide gauge (Next Generation Water Level Measurement System, NGWLMS) is used to collect water level data every 6 minutes throughout the month.

The variation in water level during the month is shown in Figure 6 along with a list of means and extreme values. This presentation is useful in identifying effects of both meteorological and astronomical forces on the open coast water level. Table 8 contains the range, high, low, and mean water level for each 12.42-hr tidal cycle.

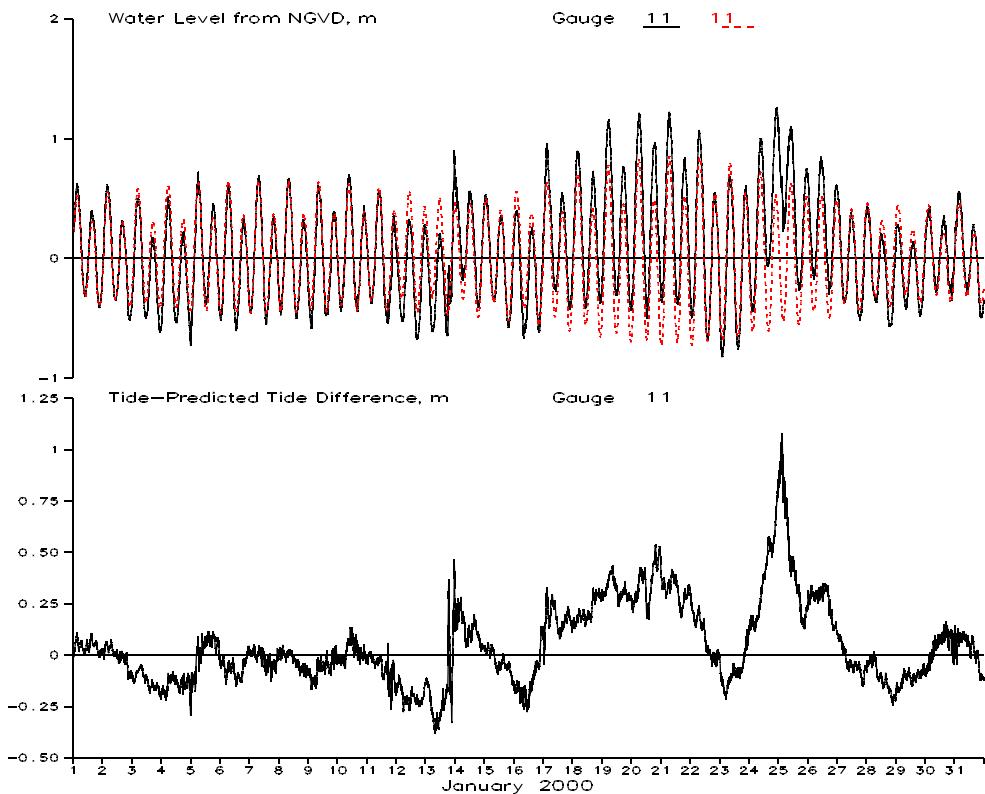


Figure 6. Water Level Variation

Table 8
Water Levels, m NGVD

JAN 2000 Tide Levels																
Day	High			Low			Mean	Range	High			Low			Mean	Range
	Time	m	Day	Time	m	Day	m	m	Day	Time	m	Day	Time	m	m	
1	0312	0.62	1	0000	-0.05	0.36	0.67	16	1442	0.26	16	0812	-0.67	-0.19	0.93	
1	1512	0.40	1	1000	-0.32	0.04	0.72	17	0312	0.96	16	2024	-0.62	0.14	1.59	
2	0412	0.62	1	2136	-0.42	0.10	1.03	17	1548	0.55	17	1024	-0.28	0.12	0.83	
2	1618	0.31	2	1100	-0.35	-0.02	0.67	18	0406	0.90	17	2206	-0.43	0.23	1.33	
3	0506	0.51	2	2218	-0.52	-0.01	1.03	18	1700	0.73	18	1042	-0.42	0.14	1.15	
3	1700	0.18	3	1124	-0.50	-0.17	0.68	19	0530	1.16	18	2254	-0.38	0.38	1.54	
4	0548	0.52	3	2318	-0.62	-0.08	1.14	19	1730	0.77	19	1136	-0.31	0.23	1.08	
4	1812	0.23	4	1230	-0.54	-0.17	0.77	20	0630	1.22	19	2348	-0.44	0.37	1.65	
5	0618	0.72	5	0000	-0.73	0.01	1.45	20	1930	0.97	20	1248	-0.50	0.27	1.47	
5	1848	0.46	5	1230	-0.39	0.02	0.84	21	0706	1.22	21	0118	-0.37	0.43	1.60	
6	0718	0.61	6	0048	-0.52	0.04	1.13	21	1942	0.84	21	1354	-0.39	0.21	1.23	
6	1912	0.34	6	1330	-0.61	-0.12	0.94	22	0748	1.07	22	0130	-0.50	0.26	1.57	
7	0748	0.69	7	0112	-0.46	0.10	1.16	22	2006	0.55	22	1442	-0.68	-0.06	1.23	
7	2006	0.35	7	1412	-0.56	-0.08	0.90	23	0824	0.68	23	0206	-0.83	-0.06	1.51	
8	0812	0.67	8	0148	-0.48	0.10	1.15	23	2154	0.60	23	1530	-0.76	-0.08	1.37	
8	2012	0.32	8	1454	-0.51	-0.09	0.83	24	1024	1.00	24	0312	-0.45	0.27	1.45	
9	0824	0.61	9	0236	-0.59	0.01	1.20	24	2300	1.26	24	1518	-0.07	0.56	1.34	
9	2100	0.39	9	1430	-0.48	-0.06	0.87	25	1018	1.10	25	0348	0.22	0.69	0.87	
10	0930	0.70	10	0306	-0.44	0.12	1.14	25	2312	0.75	25	1654	-0.27	0.23	1.02	
10	2136	0.44	10	1630	-0.44	-0.01	0.88	26	1100	0.85	26	0500	-0.18	0.33	1.03	
11	0948	0.57	11	0400	-0.38	0.07	0.95	26	2330	0.61	26	1748	-0.30	0.18	0.92	
11	2218	0.36	11	1742	-0.54	-0.13	0.90	27	1136	0.38	27	0630	-0.37	-0.01	0.75	
12	1024	0.33	12	0536	-0.53	-0.10	0.86	28	0048	0.43	27	1900	-0.52	-0.05	0.95	
12	2342	0.28	12	1724	-0.68	-0.20	0.96	28	1212	0.21	28	0754	-0.37	-0.09	0.58	
13	1148	0.21	13	0518	-0.62	-0.21	0.83	29	0142	0.29	28	1848	-0.57	-0.14	0.86	
13	2330	0.90	13	1748	-0.65	0.04	1.55	29	1424	0.14	29	0830	-0.43	-0.13	0.57	
14	1224	0.56	14	0618	-0.19	0.18	0.75	30	0342	0.44	29	2012	-0.48	-0.03	0.92	
15	0106	0.54	14	1854	-0.41	0.08	0.94	30	1518	0.36	30	0918	-0.29	0.04	0.65	
15	1336	0.36	15	0800	-0.36	-0.01	0.72	31	0312	0.56	30	2130	-0.35	0.11	0.91	
16	0300	0.41	15	1936	-0.58	-0.09	0.99	31	1536	0.28	31	1012	-0.28	0.00	0.56	

7 Bathymetry

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using a Trimble 4000 SSE GPS for positioning, in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 7 shows the last survey in December and the survey(s) in January on profile line 188, located 517 m south of the pier.

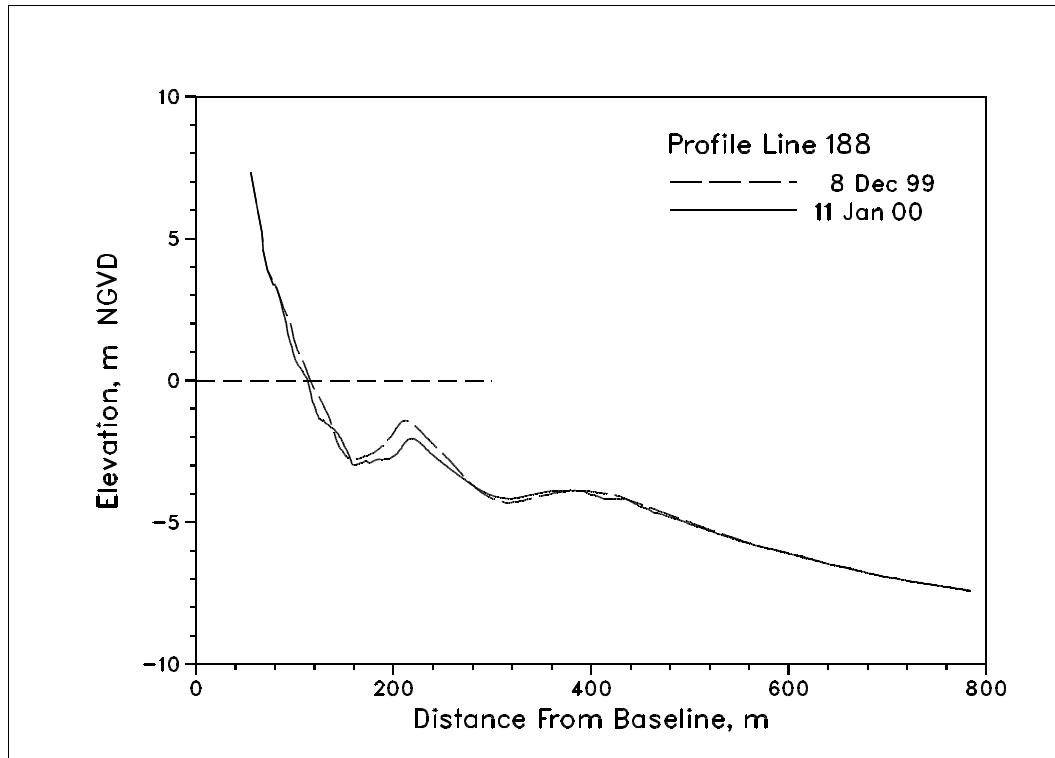


Figure 7. Monthly CRAB Profiles on Profile Line 188.

The profile envelope (Figure 8) reflects the maximum changes that occurred on the profile during 2000. Cross-hatched areas indicate changes to the annual envelope which occurred in January.

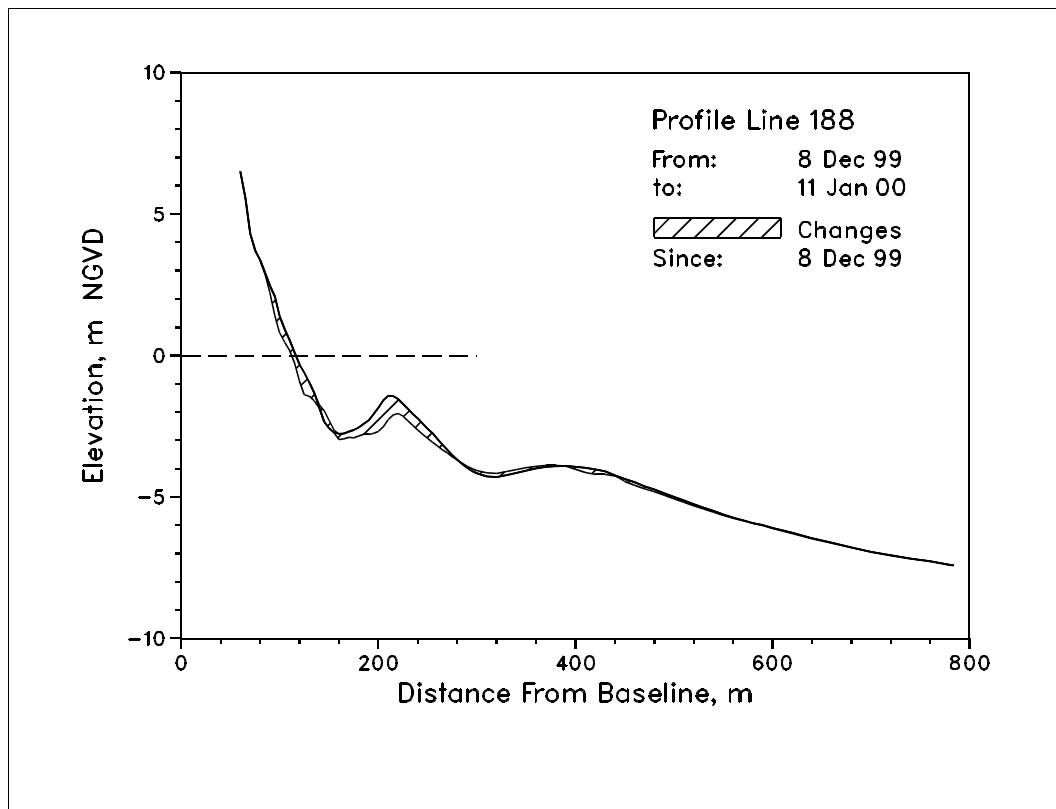


Figure 8. Profile Envelope - Profile Line 188.

B. Bathymetry. Figure 9 includes a two- and three-dimensional contour map and a change plot derived from the bathymetric survey on 9 December. Wide contour lines on the change diagram represent eroded areas; thin lines indicate deposition.

There was no bathymetric survey in January. Figure 9 is included for reference only.

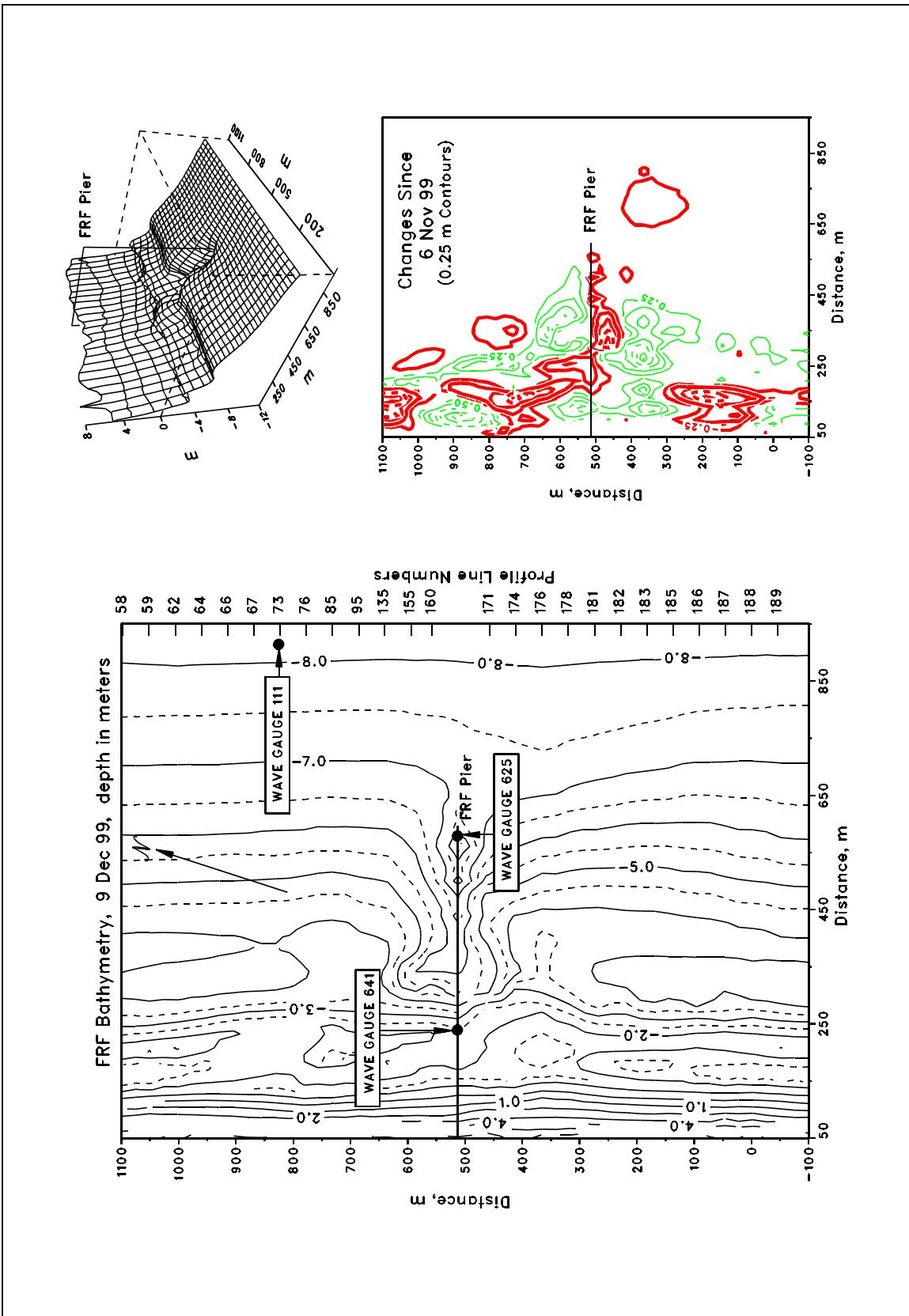


Figure 9. FRF Bathymetry, Depths Relative to NGVD

8 Special Events

A. Storm Data Collection. The following list identifies times when the wave height H_{mo} at the seaward end of the pier exceeded 2 m.

<u>Start</u>	<u>End</u>
13 Jan (2042)	14 Jan (1300)
24 Jan (1442)	25 Jan (1634)

B. Storm Synopsis.

13-14 Jan Offshore (NW) winds were generated from a high pressure system. There were no onshore winds. NW winds reached 18 m/s at 2116 EST on 13 January. The minimum atmospheric pressure was 1019 mb. The maximum H_{mo} , at gauge 625, reached 2.4 m ($T_p=7.1$ s) at 2200 EST on 13 January. There was no precipitation.

24-25 Jan A low pressure system, traveling up the Atlantic coast from Florida , produced maximum onshore winds (NE) of 19 m/s at 0134 EST on 25 January. The minimum atmospheric pressure was 986 mb. The maximum H_{mo} , at gauge 625, reached 3.5 m ($T_p=11.6$ s) at 0916 EST on 25 January. There was 61 mm of precipitation